

## THE HEALTHCARE BENEFITS AND IMPACT OF ARTIFICIAL INTELLIGENCE APPLICATIONS ON BEHAVIOUR OF HEALTHCARE USERS: A STRUCTURED REVIEW OF PRIMARY LITERATURE

Helana Lutfi MSc<sup>1</sup>, Stefan Glasauer Dr-Ing<sup>2</sup>, Thomas Spittler Dr-Ing<sup>1</sup>

<sup>1</sup> Faculty of Healthcare Science, Deggendorf Institute of Technology, Pfarrkirchen, Germany

<sup>2</sup> Computational Neuroscience, Brandenburg Technical University Cottbus-Senftenberg, Senftenberg, Germany

### Abstract

**Introduction:** Artificial intelligence (AI) is one of the most considered topics of the current time. AI has the power to bring revolutionary improvements to the world of technology not only in the field of computer science but also in other fields like medical sciences. **Objectives:** This paper assumes the adoption of appropriate AI engineering principals in previous studies, and focusses on providing a structured review of the impact of AI on human society and the individual human being as a technology user. Additionally, it opens a window on how the future will look like in terms of AI and personalised medicine. **Methods:** The paper employed a qualitative research approach and data were collected through a structured literature review. Twenty-three peer reviewed papers were identified and analysed in relation to their relevance to the study. **Results:** Previous studies show a positive impact on users' behaviour is expected in supporting their healthcare needs especially in decision-making, personalised treatment and future diseases prediction, and that integrating users in studying AI impact is essential to test possible implications of the technology. **Conclusion:** Results indicate that without a clear understanding of why patients need AI, or how AI can support individuals with their healthcare needs, it is difficult to visualise the kinds of AI applications that have a meaningful and sustainable impact the daily lives of individuals. Therefore, there is an emerging need to understand the impact of AI technology on users' behaviour to maximise the potential benefits of AI technology.

**Keywords:** artificial intelligence; applications; behaviour; healthcare; review

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### Introduction

Artificial intelligence (AI) is the theory and development of computer systems to be able to perform specific tasks that normally require human intelligence. AI tasks improve healthcare through assisting in diagnosis (diagnostic algorithms), monitoring (virtual assistant), treatment (decision making) and prevention (prediction of future disease). AI is based on a programme that can make decisions or perform a service independent of human intervention according to its setting, user data input and experiences.<sup>1</sup> According to the concept of behaviourism; environment, through associations and consequences, shapes the behaviour of artificial intelligent technology.<sup>2</sup>

However, unintended and unexpected downstream societal consequences of AI could be both negative and positive. As a result, there is a fear for the potential loss of human oversight over intelligent machines and of the potential harms that are associated with the increasing use of technology tools.<sup>3</sup> The lack of direction and evidence on how

AI could actually benefit patients and consumers has led to an emerging need to understand the impact of AI. Without a clear understanding of why patients and consumers need AI in the first place, or how AI could support individuals with their healthcare needs, it is difficult to imagine the kinds of AI applications that would have meaningful and sustainable impact on individual daily lives.<sup>4</sup> Describing the potential impacts would provide a comprehensive description of future AI opportunities in healthcare, highlight for AI developers the most suitable AI applications that provide the most healthcare benefits, and how to effectively use AI while maintaining people's privacy.<sup>5,6</sup>

A systematic review on machine behaviour in Germany proposed a new interdisciplinary field of scientific study concerned with empirically studying the impact of intelligent machines on users.<sup>3</sup> For instance, studying animal behaviour is done through integrating ecology and evolution properties. Similarly, the benefits of artificial intelligent on healthcare cannot be fully understood without studying the impact on users and the social environment properties on which

intelligent machines behave.<sup>3</sup> This concept was supported by other findings which had revealed that in order to study the impact of intelligent machines, it is necessary to understand the ways in which the introduction of AI application systems could alter human beliefs and behaviours.<sup>7</sup>

Another review discussed the impact of technology on people with autism spectrum disorder and identified five important factors to be considered when analysing the impact of any technology on users. These are: “Accessibility”, “User Experience”, “Technology Usability Elements”, “Sustainability” and “Public Value”. In addition, social factors concerning user behaviour such as lifestyle, education level, cultural beliefs, and attitudes towards technology use should also be considered.<sup>8</sup>

To measure the potential impact of different AI capabilities on social good, Chui recently identified various types of meaningful problems that can be solved by one or more AI capabilities through mapping AI use cases to seventeen domains. These domains can include security and data privacy, economic empowerment, education, sustainability and impact on environment, infrastructure, education, public and social sector, information validation and verification.<sup>9</sup>

The aim of this study was to review the literature review to i) identify and examine the literature on the potential benefits of implementing AI among healthcare users and provide information to facilitate studying the impact of AI on end users in medical science and ii) identify suggested gaps in previous studies that suggest current and future directions for research. The research questions to be answered by this review were: how does the use of artificial intelligence contribute to healthcare provision benefits, and how does artificial intelligence shape user’s behaviour and perspectives towards technology’s use?

**Methods**

A structured literature review was undertaken. Four databases were searched: IEEE Xplore Digital Library, PubMed, Semantic Scholar and Mendeley. Searches were based on keywords and the search strings listed in Table 1.

**Table 1.** Search strings and keywords used for the review.

Search Strings
(Artificial Intelligence) AND (Healthcare)
(Technology) AND (Healthcare) AND (Impact)
(Artificial Intelligence) AND (User) AND (Impact) OR (Perspectives)
(Artificial Intelligence) AND (Medical) AND (User) AND (Behaviour)
(Artificial Intelligence) AND (Factors) AND (User)

Papers in social, computer and medical related science published in English, in journal articles and conference papers between January 2016 and August 2020 were considered relevant. Papers related to natural science or

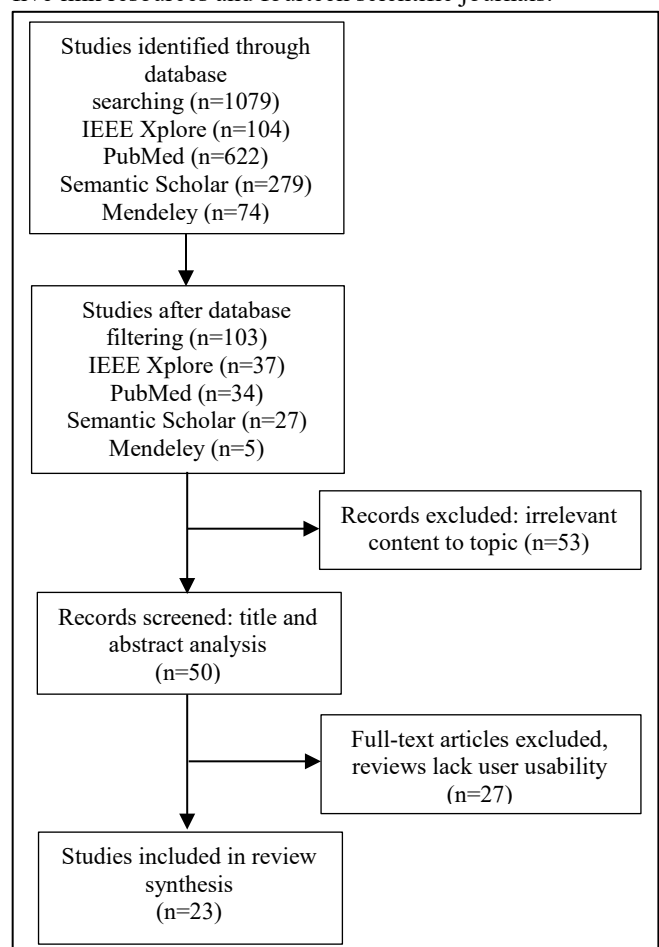
engineering were excluded. To answer the structured review questions based on the selected articles and develop a general knowledge of the concepts, the following inclusion and exclusion criteria were applied. (Table 2)

**Table 2.** Inclusion and exclusion criteria for the review.

Inclusion Criteria
Level of relevance to AI in health
Level of innovative approach with focus on AI technology
Impact of AI applications on users
Factors effecting human-AI relationship
Exclusion Criteria
Demographics
Nature of the healthcare problem addressed
Algorithms
Technology development

**Results**

A total of 23 studies were obtained. (Figure 1) These studies were analysed under different metrics, such as year published, document type, paper title and abstract. Selected studies included two conference papers, two book papers, five link resources and fourteen scientific journals.



**Figure 1.** Database search selection flowchart.

The origin of studies were also analysed and results observation has shown that majority of the studies were originated from Europe; twenty from Germany, one from United States of America, one from Brazil and one from Saudi Arabia.

## Discussion

The key findings of this study based on the research questions are as follows.

*How has artificial intelligence contributed to healthcare provision benefits?*

Advanced technological development such as AI has not in any way altered the mutual interaction established by a healthcare provider and a patient. However, it has influenced healthcare users and health provision with its own set of positive and negative aspects, for which the healthcare providers must be well equipped to handle. For example, the thought of human interaction being replaced by IT tools came into existence. However, human behaviour itself cannot be copied in totality by technology.<sup>10</sup>

A similar review in Canada, that addressed implementation of AI in healthcare, showed that machines do not replace healthcare providers since it is not about making better decisions, rather about collecting and having better information. Therefore, maximising the healthcare benefits can be through reaching the maximum potential of combining both the human and AI technology. For instance, clinical information such as whom to treat, when to treat and what to treat with, are already known information however, using AI to provide predictive analytics and clinical decision supporting tools would lead healthcare providers to act earlier to expected healthcare complications and problems long before they might acknowledge the essential to act to.<sup>11</sup>

Yeasmin surveyed 68 doctors, dentists and students in medicine and other medical fields on the impact of AI in the medical context. Approximately two-thirds of respondents had used artificial intelligence in their healthcare profession and almost all of them believed that AI is relevant and valuable for future applications of medicine and that artificial intelligence's impact is expected to be strongly positive on users. The majority felt that AI is not dangerous to people. However, the majority of the respondents had identified the significance of the development of artificial intelligence in a specific context. For instance, more than half of the participants noted the importance of directing the focus of artificial intelligence to diagnosis and the prediction of future diseases for patients.<sup>12</sup>

*How does artificial intelligence shape user's behaviour and perspectives towards technology's use in healthcare?*

Grindle et al., reporting on the design and user evaluation of a wheelchair mounted robotic assisted transfer device, noted that the views of users and caregivers are important when evaluating any type of technology.<sup>13</sup>

The role of social integration of artificial intelligence in the

human-AI relationship is not only about humans using AI or humans interacting with AI but is also about the micro-relationships that involve functional interactions. For instance, in fully autonomous cars, the human will interact with the car using voice, receiving audio and visual information, and possibly haptic feedback. Each of these interactions performs different functions and engages in services offered to the human. The human trust in the car will be influenced by these different interactions.<sup>14</sup>

Trust is a psychological mechanism to deal with the certainty between what is known and unknown. Similarly, human trust shapes clinicians use and adoption of AI. Their trust in AI is influenced by the complex algorithms, data sensitivity, cognitive bias and their lack of subject knowledge of AI. and increasing transparency and encouraging fairness are among the possible ways to improve trust in artificial intelligence.<sup>15</sup>

Trewin addressed the issue of fairness of AI use in healthcare - the ethical concept of justice, and noted that fairness of treatment for society can be impacted by various attributes such as age, gender or race as well as the diversity of ways that people adapt to technology use. Individual fairness would require similar individuals to have similar health outcomes.<sup>16</sup>

According to a recent paper, "It takes two to tango", Dodd and Cordella noted that bringing together users and AI is important to create a public value and that user interactions are key components by which AI and algorithmic processing shape personalisation in healthcare. Therefore, to understand how emerging technologies such as AI present an impact on healthcare population, it would necessary to understand the impact of a specific function of AI technology on the user through personalised healthcare.<sup>17</sup>

Understanding AI impact on user's behaviour is essential to control AI technology actions, maximise their benefits and minimise their harms. Unintended consequences of AI applications can produce downstream both positive and negative societal consequences. Predicting the factors can help to understand how human biases combine with AI to alter human emotions or beliefs.<sup>3</sup>

## Conclusion

The literature expectation is that artificial intelligence (AI) will generally have a more positive than negative impact on society in supporting patients with their healthcare needs.<sup>18</sup> However, addressing how implementing AI technology would shape the behaviour of healthcare users in the healthcare sector remains an unstudied key decision factor in making a case for or against applying AI in healthcare.<sup>19,20</sup> Even the most autonomous and clever AI will exist within a social system in which it needs to interact with humans and other AI systems. Therefore, AI systems must become socially integrated.<sup>21</sup> Any integration of AI into the human social system will necessitate a form of relationship on one

level or another between the human and AI in society to improve the quality of healthcare. This means that humans will always actively participate in clinical decision making that will influence the operations of AI.<sup>22</sup> For systems that will make or influence decisions affecting human lives, it is critical that a broad range of users are involved in designing AI implementations and studying AI impact. This should include people with disabilities who can help developers think through the possible implications of the AI technology, and test the technology's performance on under-represented populations.<sup>23</sup>

**Corresponding author:**

Helana Lutfi  
 Member of the Scientific Staff  
 Deggendorf Institute of Technology (DIT), European  
 Campus Rottal - Inn.  
 Raum: EC.B 0.16  
 eMail: [helana.lutfi@th-deg.de](mailto:helana.lutfi@th-deg.de)  
 Tel.: 0049 (0) 991 3651-8816

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